

# ThinkCycle: Supporting Open Collaborative Design for Product Innovation and Learning in Sustainable Engineering

Nitin Sawhney, Ph.D. Candidate, MIT Program in Media Arts and Sciences

**Thesis Objective:** Understanding the role of online collaboration, pedagogical approaches and intellectual property rights towards product design innovations in sustainable engineering.

**Research Questions:** How can we create an environment that encourages distributed individuals and organizations to tackle engineering design challenges in critical problem domains? How should we design appropriate online collaboration tools, pedagogical approaches with real-world exposure and social incentives for innovation in sustainable engineering?

The thesis seeks to address these interconnected issues using three main approaches:

## I. Developing Collaboration Tools for Open Source Engineering Design

*Research Goal:* What is the role of Open Collaboration towards design of innovations in sustainable engineering? Can distributed individuals and organizations work towards cooperative products through an online platform? How should a web-based system be designed to support such distributed collaboration for product innovation?

*Approach:* Development and implementation of *ThinkCycle*<sup>1</sup> (Apr 2001-Aug 2002). It is an online platform that archives ongoing challenges, evolving design rationale, peer reviews and intellectual contributions within a public online database. It also provides collaboration features for distributed design teams to work on engineering design projects (in an open or proprietary manner). It has been designed iteratively with ongoing feedback from students in courses and users worldwide. It is now a robust and scaleable distributed system, similar to large open source software communities like *SourceForge.net* or international development sites like *DevelopmentGateway.org* developed by the World Bank.

*Outcomes:* Over 1200 users worldwide have posted hundreds of design contributions in nearly 40 topics of interest. Content on the site is ranked among top 5-10 hits on many *Google* queries, such as “cholera treatment”, “passive incubator” or “hand power generator”. An evaluation study with students from courses conducted at MIT, has revealed many design criteria, limitations and affordances for online collaboration tools and their role in engineering design for critical problem domains. An early journal paper on this project was published in January 2002, while a recent paper for a doctoral colloquium was accepted in August 2002 for the Conference on Computer Supported Cooperative Work.

## II. Supporting Learning and Real-World Collaboration in Studio Design Courses

*Research Goal:* How should sustainable design with real-world problem domains be incorporated into engineering courses in university settings? What is the nature of learning and collaboration among students in such experimental courses? What is the role of instructors, domain experts and external stakeholders in the design process?

*Approach:* In spring 2001 and 2002 experimental design studios were conducted at the Media Lab, called *Design that Matters*<sup>2</sup>. The goal of the studio courses was to provide engineering students with exposure to design challenges posed by individuals and organizations working in underserved communities. Student teams built working prototypes

---

<sup>1</sup> <http://www.thinkcycle.org>

<sup>2</sup> <http://www.thinkcycle.org/dtm>

with peer review from local domain experts, and documented their ongoing design solutions using ThinkCycle. Similar courses<sup>3</sup> are being offered by several faculty this year at MIT, Bangalore, Portugal, Kenya and Brazil.

*Outcomes:* Working prototypes from several design projects have been demonstrated in areas such as clean water access, cholera treatment devices, low-cost eyewear, and passive incubators for premature infants; many of the innovations are being field-tested, patented and licensed for commercial production. An evaluation study conducted with 17 students from the course (using online surveys and interviews) has revealed learning outcomes, benefits of the studio courses, and the manner in which collaborative design projects were conducted. A report on this study was written in July 2002 and a recent paper summarizing these results was accepted in August 2002 for the conference on Engineering Education in Sustainable Development (EESD).

### III. Understanding Intellectual Property Rights in Open Collaborative Design

*Research Goal:* Understanding how Intellectual Property Rights (IPR) are perceived and redefined in the process of open collaborative design and field-deployment of product innovations developed in university settings. Proposing a framework for IPR that provides appropriate policies, incentives and mechanisms to ensure fair and timely access to scientific innovations in developing countries and critical problem domains.

*Approach:*

*A. Review of IPR in the Scientific Community:* Understanding key issues, social incentives and legal frameworks, based on existing literature and discussions with the Technology Licensing Office at MIT.

*B. Emerging IPR in DtM Projects:* Interviews with lead members of 6 design projects conducted using ThinkCycle in the MIT Design Studio in 2001 and 2002 (3 of which are being commercialized or deployed in the field, and 3 which remain in the design stage).

*C. IPR in University Research:* Interviews with 3 innovators in university research settings, who deployed their socially motivated innovations on the field i.e. Susan Murcott and Amy Smith at MIT and Dr. Ashok Gadgil at Berkeley and Lawrence Livermore Labs.

*Outcomes:* Research study in progress; currently writing up results from ongoing interviews.

#### References (ongoing papers based on thesis research)

1. Sawhney, N., Griffith, S., Maguire, Y., Prestero, T. ThinkCycle: Sharing Distributed Design Knowledge for Open Collaborative Design. *International Journal of Technologies for the Advancement of Knowledge and Learning (TechKnowLogia)*, Volume 4, Issue 1, Jan-March 2002.
2. Sawhney, N. Collaborative Design and Learning in Studio Courses: Summary of Online Survey Conducted at MIT. 23-page Technical Report (Unpublished), July 10, 2002.
3. Sawhney, N., Prestero, T., Griffith, S., Maguire, Y. ThinkCycle: Supporting Open Source Collaboration and Sustainable Engineering Design in Education. *Engineering Education in Sustainable Development (EESD)*, Delft University of Technology, Delft, The Netherlands. October 24-25, 2002.
4. Sawhney, N. Open Cooperative Design in Studio Courses: The Challenges for Online Collaboration (Doctoral Colloquium). *ACM 2002 Conference on Computer Supported Cooperative Work (CSCW 2002)*. New Orleans, Louisiana. November 16-20, 2002.
5. Sawhney, N. Understanding Intellectual Property Rights (IPR) through Case Studies of Sustainable Design Innovations in University Settings. Forthcoming Technical Report, Aug-Sept 2002.

---

<sup>3</sup> <http://www.thinkcycle.org/global-dtm/>